ILLINOIS SOLAR DECATHLON

ADAPTHAUS

FLEXIBLE, SUSTAINABLE, AFFORDABLE

BUILT CHALLENGE 2021
UNIVERSITY OF ILLINOIS AT URBANA CHAMPAIGN

ADAPTHAUS

ARCHITECTURE

PROJECT BACKGROUND AND DESIGN IDEA

Illinois Solar Decathlon is building a modular house which revolves around the concepts of adaptability and affordability. The target market for our project includes young professionals in the Urbana - Champaign area. ADAPTHAUS promotes and displays core concepts of sustainability and accessibility through its design features, layout, modularity, and subsystem integration. The design provides users the flexibility to efficiently use the space inside the house for multipurpose activities and adapt to the needs of the occupants over time. Illinois Solar Decathlon conducted housing market surveys to understand the needs of young professionals in the Urbana Champaign area. Our design serves the current needs of the client while also incorporating provisions for future requirements. This is where the concept of modularity emerges, and the idea of an adaptable space becomes a core concept for our project. We envisioned that a college graduate can initially start with one module when they are single and can expand to two or three modules once they have a family and kids. When their kids leave the house for college, they can reduce their square footage by renting their third module or selling it back to a homebuilder.

Thus, ADAPTHAUS through its multidisciplinary integrated design approach provides a novel solution apt to the needs of the client and embodies a sustainable lifestyle. Our interior design focuses on spatial efficiency by using flexible furniture to have multipurpose rooms. Adaptability and affordability were the core pillars of sub-system design. The project is currently located in the city of Champaign, Illinois. The scope of the project is the design and construction of 2 modules of the adaptable design, further designated as modules A and C.

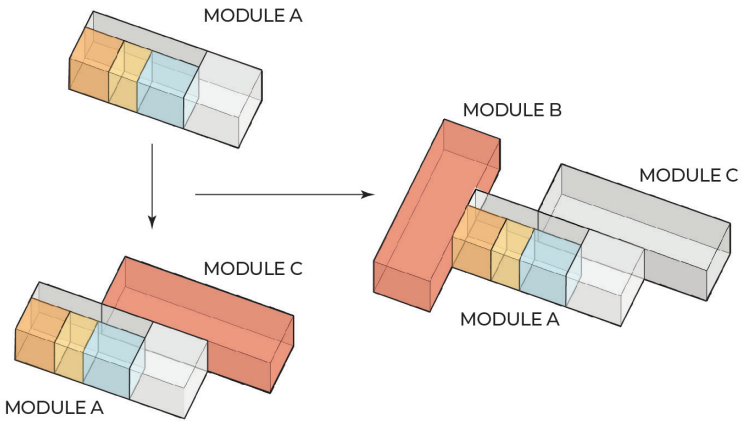
ADAPTABILITY AS AN ARCHITECTURAL CONCEPT

The idea that emerges to generate the volumetric expression of this project is rooted in the ability of architecture to be adaptable and resilient to different conditions presented in a user's life, and how these needs and conditions evolve through time. The initial visualization begins from here. The project is conceived as a single module, with the necessary needs for a single occupant or a couple to live comfortably in a transformative environment. The program within this singular module is a kitchen, living/resting area with adaptable furniture, bathroom, laundry and mechanical room. This single module is designated as module A in the project and will be the basic building block of the house, with all the required spaces for comfortable living for a single occupant or a couple. The idea then evolves to a possibility for this module to attach itself to other modules, maintaining itself as a core element in the house but connecting the rest of the elements, for a growing family or growing spaces.

The distribution arrangement of the program of this module allows it to be attached to other modules in different directions. The initial intention for this house was to portray the possibility of module A to be attached to 2 additional modules (B and C) and demonstrate the adaptability of the space for a growing family or growing spatial opportunities. The design that will be further developedin the Build Challenge 2020, is the composition of Module A (core module) and module C (perpendicular to module A). The adaptation of module C as an additional module expands the basic program to a house that now has a dining room, a versatile working space, and a study / extra bedroom. This extra bedroom can serve as additional resting space for a growing family, and adaptable office with flexible furniture, or an Airbnb room to sustain economic growth generated by the available space in the home. The core programs are still maintained in module A, optimizing construction and energy management to a central core element.

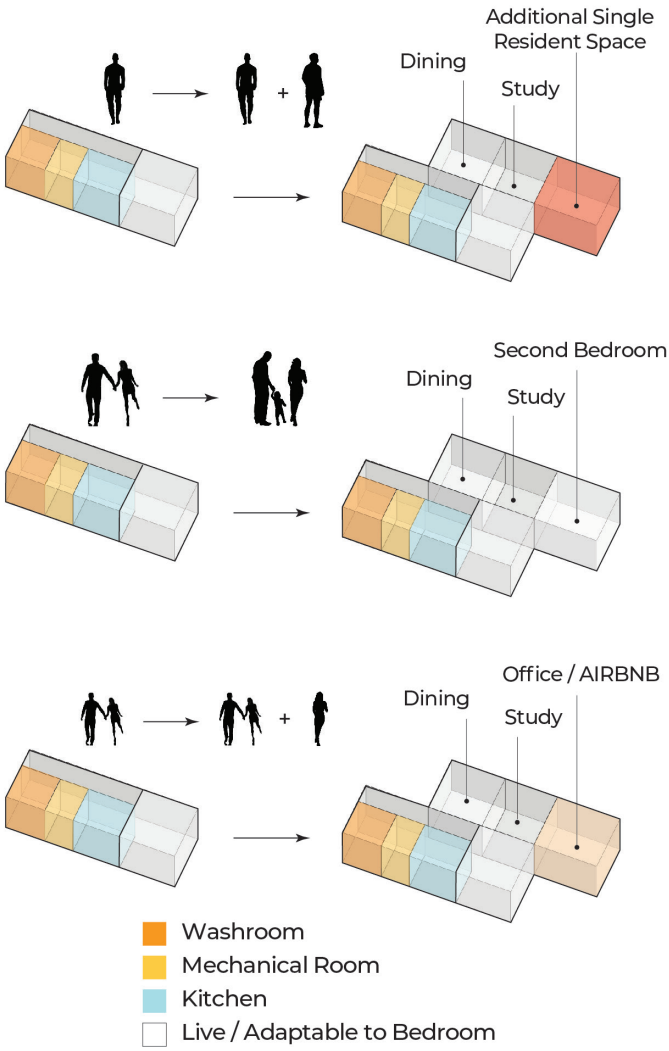
MODULAR ARRANGEMENT

HOUSE PROJECTED GROWTH



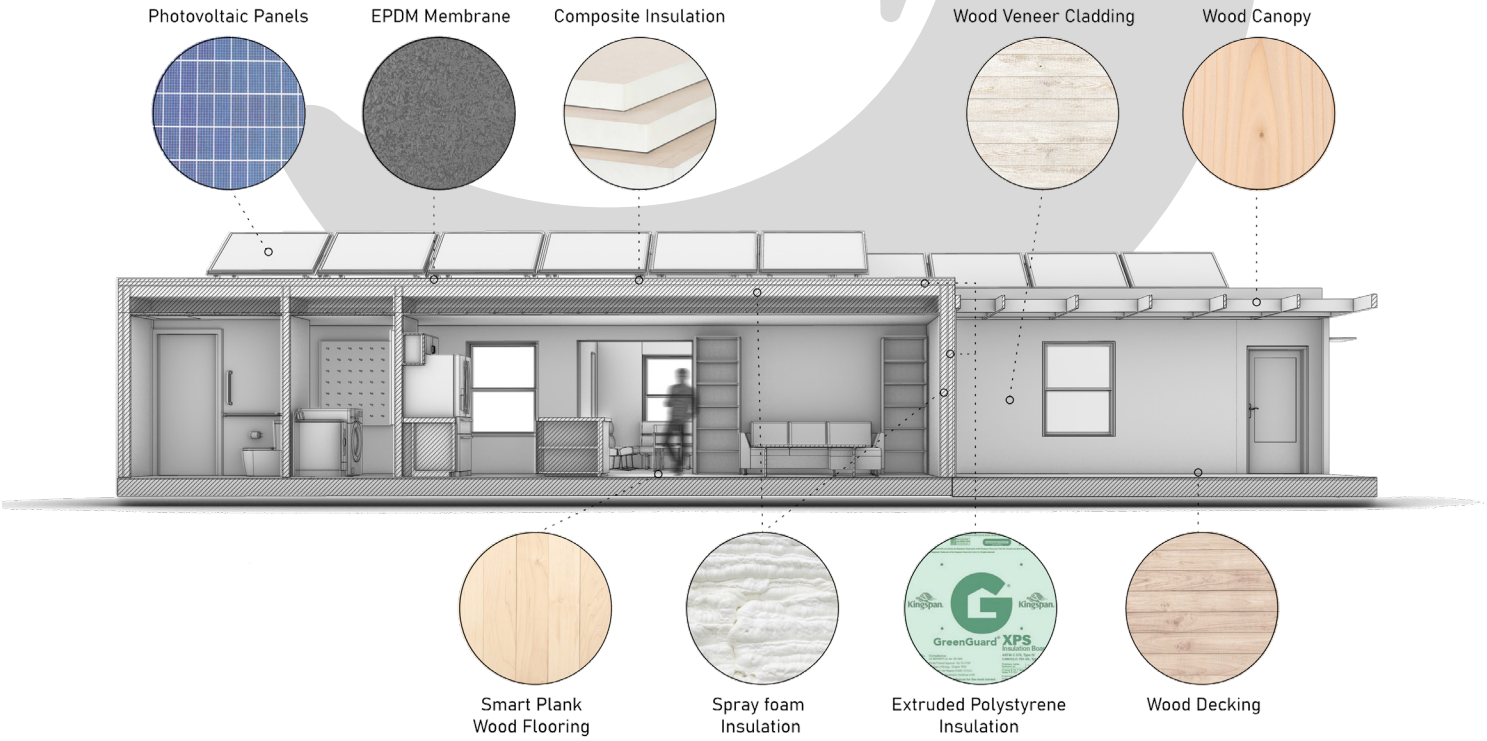
CURRENT SCOPE OF WORK

LIFE ADAPTABILITY

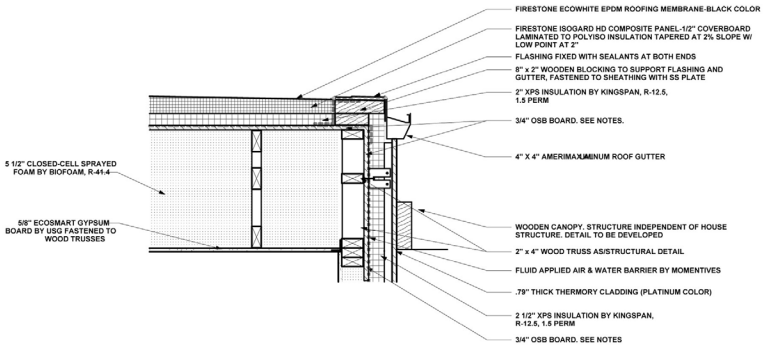


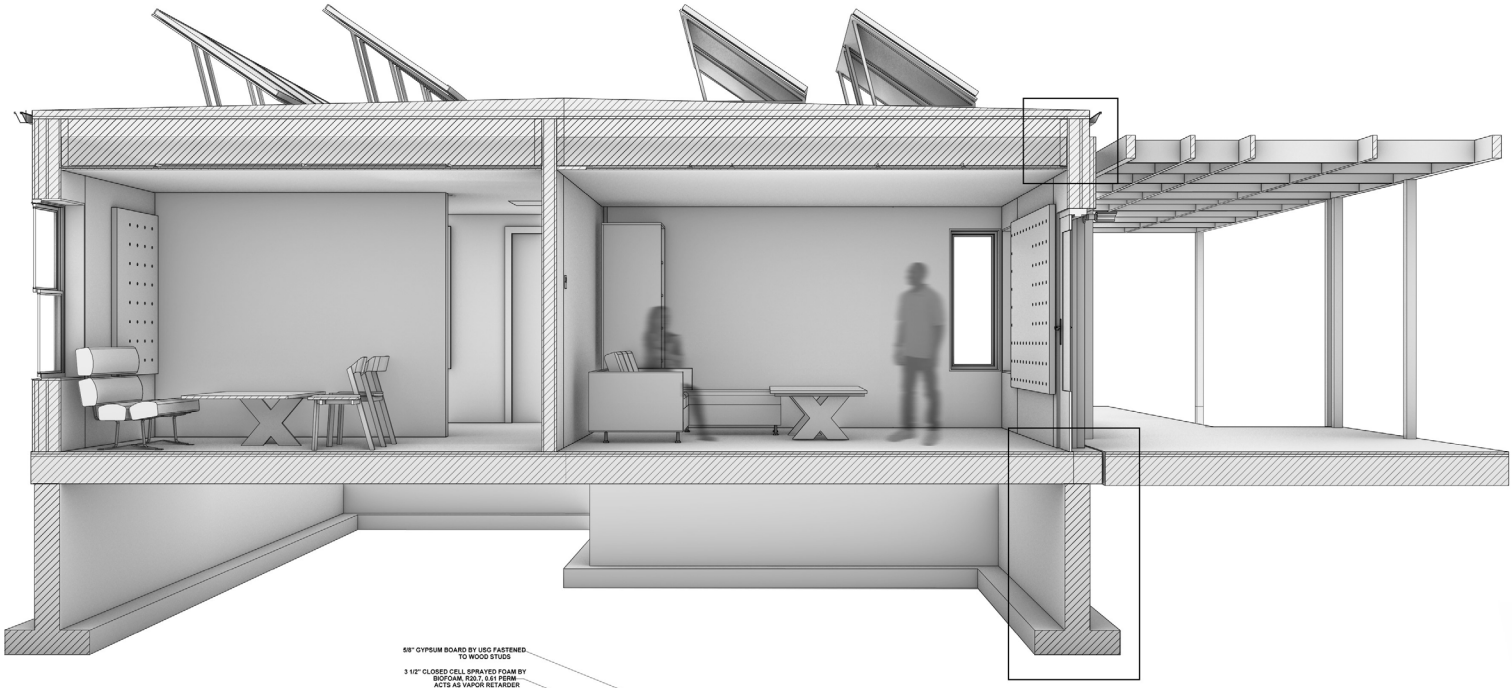
ENVELOPE AND MATERIAL AS PERFORMANCE REGULATORS

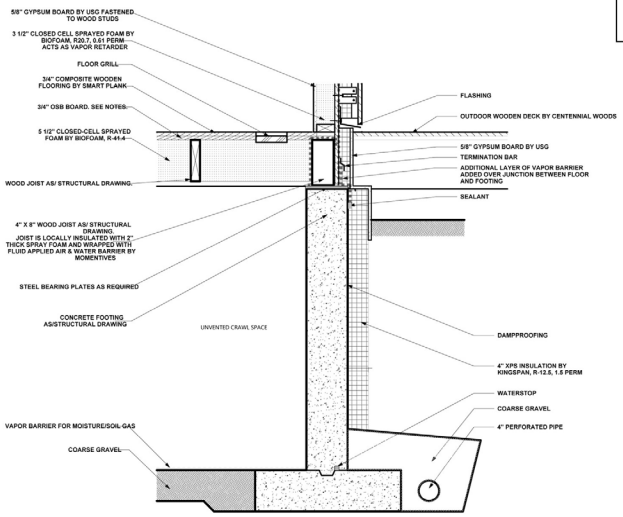
To follow the premise of sustainability as a guiding principle in this project, the building envelope of this house was designed as a fundamental energetic performance feature of the overall design. The envelope design is based on the local climate of Champaign, IL, and thus features continuous insulation outside the structure to alleviate thermal bridging. The R values that are achieved with the envelope design are R28 for walls, R33 for floors, and R62 for the roof. Since the wooden frame structure used in this house has a relatively high thermal conductivity, the continuous insulation is utilized around the wood frame to reduce the risk of thermal bridging. Closed-cell spray foam insulation in the cavity between the stud joists reduces the thickness of the continuous insulation and maximizes interior space. The continuous insulation reduces the risk of condensation since the temperature of the interior face of the sheathing is raised above the dew point. The fluid-applied water resistive barrier acts as an additional air barrier and is vapor permeable. In order to achieve 0.03 ACH airtightness, ADAPTHAUS utilizes the low airpermeability of the closed-cell spray foam cavity insulation. The roof utilizes Ethylene Propylene Diene Monomer (EPDM) membrane on the outer surface. On the outer layer of this robust thermal envelope lies wooden cladding elements that provide additional insulation capacity to the general structure and are merged with some of the other exterior visual elements of the house, composed of wood, as are the decking and canopy. All the windows of the project are double-pane glass, helping maintain an optimal performance throughout the envelope.



BUILDING ENVELOPE DETAILS







SITE ADAPTATION AND STRATEGIES

The site adaptation of these modules is a fundamental part of the project, using the versatility of the units to create the most efficient layout for the specific Champaign location selected for the construction of the site.

Module A, the core module of the house, is located facing the street, allowing the opportunity to receive visitors and residents directly as the main point of entrance for the house. This also informed the decision of the placement of a decking and canopy system in the void between the 2 modules and south facing space, creating the opportunity of an outdoor livable space that lends itself for the opportunity of outdoor activities and interaction with the neighborhood. The canopy, which will have a trumpet vine integrated as a vertical and horizontal planting element, also provides additional shading for this façade of house. The void between the modules in the back of the house is maintained a private courtyard treated with hardscape.

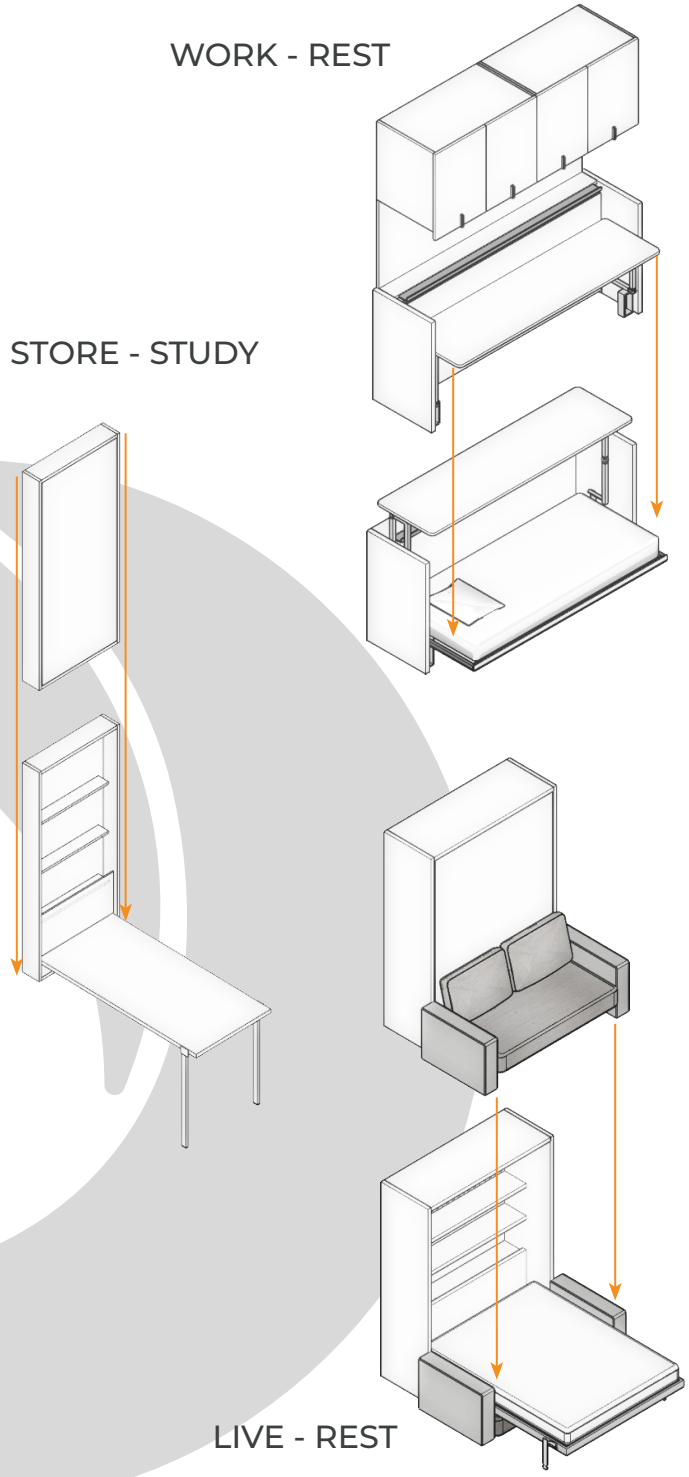
INTERIOR VERSATILITY

Part of the adaptability that is thought as a concept for this house relates to its ability to be versatile in its interior to optimize the use of the available space. To achieve this, the selection of furniture and distribution of spaces was fundamental.

Module A consists of a living/sleeping space as part of the program and needs to have modular pieces of furniture that convert from a living room couch to a bed. A similar case occurred in Module C, where the office space of the house is also potentially converted in an additional room or into an Airbnb space, necessitating again the introduction of adaptable and transformative furniture. To achieve this, the design team conceived these spaces with the introduction of adaptable furniture provided by Resource Furniture. The needs of the house are met by these adaptable furniture pieces that emphasize the versatility and modularity that exists in the very core of the house.

The interior versatility of the house is also complemented with the introduction of pegboards as part of the interior features of several rooms and spaces, allowing these areas to have an adaptable element on the wall, that can have various interior functions, as shelving and alternate storage.

All these elements are distributed in a smart way, optimizing the use of the interior space, and allowing ADA circulation around the entire house, while still having that versatility aspect which is deeply embedded in the design of this home.



ENERGY AND WATER MANAGEMENT

As much as the envelope helps control the energy consumption in the house by keeping climate conditions stable in the interior through the season, the energy system for this house was also a fundamental aspect of the design and is thought as part of the guiding design elements for the project.

The house gathers solar energy through PV panels. Being a Positive Energy Home, the energy acquired is all the energy needed for the house, with additional energy generated and stored.

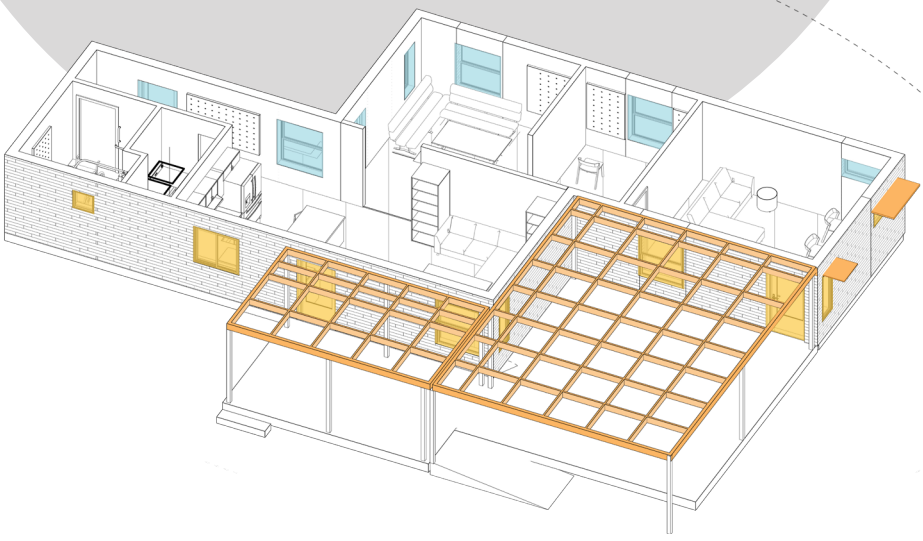
Because of this, the energy gathering was fundamental. The roof of the modules is designed to fit the necessary PV panels to collect the energy for the home, and 12 south facing PV panels are placed in each module. This location allows for an optimization of energy collection, that is articulated to the spatial distribution of the home.

Water collection is also a fundamental piece of the sustainable characteristics of this house and is achieved through strategic collaboration of water design with the landscape distribution of the home, optimizing collection and utilization.

NATURAL AND ARTIFICIAL LIGHT MANAGEMENT

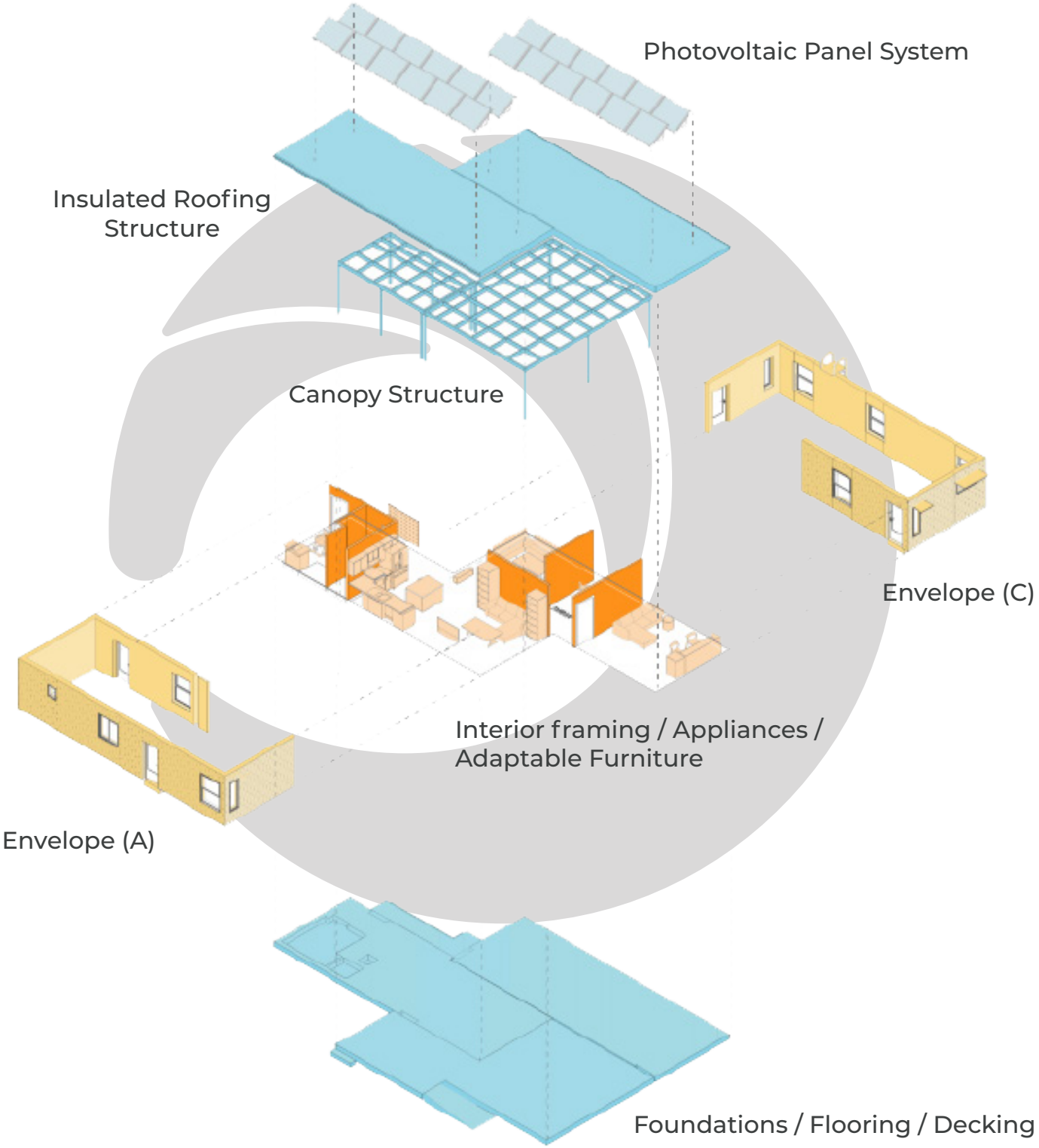
The two modules that conform this house are planned to optimize the intake of natural light, taking advantage of the site orientation and managing glare through passive shading strategies. East facing windows are designed with overhangs made of the same wooden material as cladding to control glare, while south facing windows are offered shade through the exterior canopy of the house, while paralleling optimizing natural light intake. North facing windows do not use passive shading elements, and acquire additional natural light access in Module C.

Artificial light in the interior of the house is also thought as a sustainable system, utilizing only efficient LED lights to reduce energy consumption and offer long durability for the users.



BUILDING SYSTEMS INTEGRATION

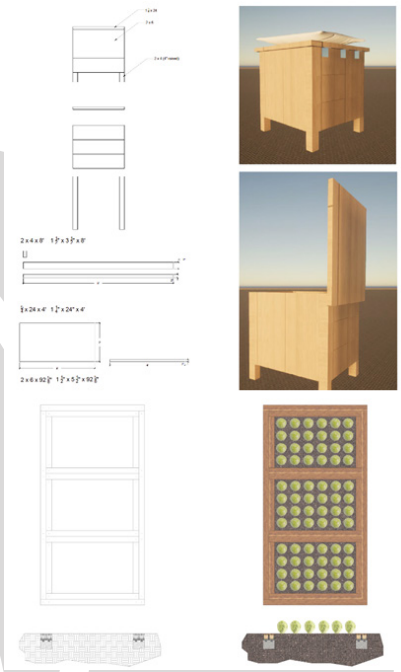
This section contains an exploded axonometric view of the project showing the integration of the different systems utilized (structure frame, envelope, cladding, furniture, PV panels, deck, canopy, fenestrations).



ADAPTIVE OUTDOOR SYSTEM

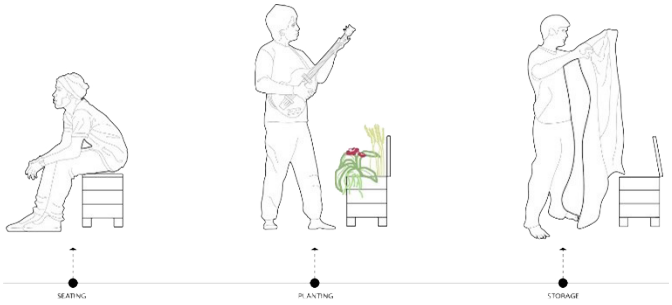
Presented as an extension of the architectural concept of modularity and adaptability, the landscape design is actively and passively designed to embody the idea of a productive system. The design takes on a curvilinear form that works to complement the modular nature of the embedded architecture with planter beds seeded with native plants. The multilayer planting beds build a robust micro-ecosystem that mitigate micro-climate around the house and attract pollinators to the food gardens. The movable wooden boxes can be a seater by the herb garden, or a storage box that can be moved indoors when necessary. The boxes encourage residents to reconsider the flexibility and use of semi-outdoor spaces and suggest the opportunity to design your private space with ease. The space flexibility provided by the design echoes the necessity of adaptable houses that allow changes in the configuration as users' needs evolve over time.

The modular boxes serve as an everyday use for the landscape. This allows for the residents to use the modular boxes as seating, as planters, and as storage compartments. These modular boxes are located on the south deck, and they can be arranged to accommodate for group gatherings or other plant designs. The modular boxes are constructed by wood and designed to fit residents' needs.



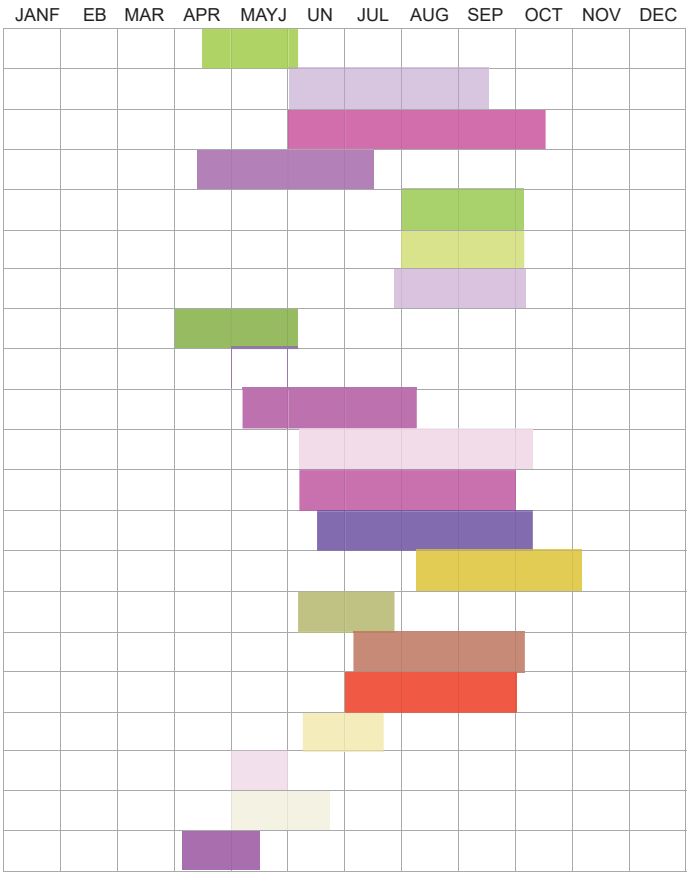
PLANT PALETTE & LANDSCAPE

Plant palette in this sustainable home's landscape design, the emphasis on ecological sustainability is just as strong as the sustainability of the home itself. On site, the planting design, aside from the small food garden, consists almost solely of native plant species, aside from a couple of tall pink phlox varieties and some sod grass varieties for lawn space, all of which are perennials. From Red Osier Dogwood and Indian Grass to Pennsylvania Sedge and Wild Geranium, the native plants help to restore more native soil conditions and keep soils healthier and microbially diverse. The native plants also flower at various times from Spring through fall, and provide a source of food for native pollinators, as well as small native bird species. The plant communities have the potential to provide habitat for additional wildlife, and require minimal maintenance once mature, as they will be mostly self-sustaining. The plant communities will serve as an ecological hotspot within the surrounding urban environments. The aesthetic value of the ecologically inviting native plant communities is a more than ample garden reward, even during the cold winter months. The native plant communities also require less water than the average garden. As an additional, sustainable, ecological measure and benefit, the home will include its very own greywater system. This will feature a septic tank and aquifer pipes, through which filtered greywater can permeate the surrounding soils and provide an additional reliable water source to the two large western edge-bordering native plant communities on the property. The food garden will help the residents to interact more with nature and save some produce and herb-related trips to the grocery stores while also eliminating some plastic bag use. Fresh produce and herbs are irreplaceable. The planned food garden is arranged such that many of the plants will provide some benefits to their surrounding ones, and the mint will not only be a great herb for teas and sweets, but its strong scent will help to deter aphids from the remainder of the food garden plants.



SPECIES / CULTIVAR	ECOLOGICAL VALUE
Carex pensylvanica	Provides nesting habitat for various migratory waterfowl, and is used by ducks as nesting material. It also provides habitat for Sharptail Grouse and Prairie Chickens, in addition to other wildlife where present.
Echinacea pallida	The seeds are a source of food for the American Goldfinch and other birds, and their nectar is a food source for hummingbirds. This species tolerates a variety of soil types and almost never succumbs to any pests or diseases.
Callirhoe involucrata	This flower serves as a significant pollinator plant, and is a host plant for larvae of various Hairstreak Butterflies. Tolerant of both drought and poorer soil conditions, this native plant is likely to thrive if conditions change, and still provide nectar for a variety of wildlife.
Geranium maculatum	This species is a major source for pollinators, particularly a variety of bees. Their inclusion in this planting design will further encourage native pollinators to visit the garden, with their microscopically bright blue, attractive pollen.
Sporobolus heterolepis	This native prairie grass helps to stabilize soils while also providing habitat for wildlife. It functions well in prairie plant communities and helps to further establish them.
Sorghastrum nutans	A major component of prairie plant communities, this native grass grows well in nearly all soil conditions. It helps to establish native plant communities and offers additional habitat for small wildlife. It also provides ecological grass diversity.
Allium canadense	A major component of prairie ecosystems this species is tolerant of most soil conditions and can easily adapt to soil changes. The flowers of this species attract a very wide variety of bees, as well as some wasps. The various parts of the plant provide food for a wide variety of insects.
Carex rosea	This species provides seeds for various songbirds and upland gamebirds. It is also a source of food for many species of insect, which in turn are a significant source of food for many of bird and mammal species.
Allium schoenoprasum	Native to North American boreal forest, chives are grown for culinary purposes and as an alternative to some other native varieties of allium. They provide nectar for a variety of insects, particularly bees and flower flies.
Phlox x glaberrima 'ForeverPink'	While this phlox is a hybrid cultivar, it shares most characteristics with similar native species. An attractive nectar source for adult Lepidopterans, the flowers have tall stalks making them unattractive to most other insects. For some moth species, Phlox can also be a larval host plant.
Pycnanthemum virginianum	With flowers that are very attractive to a wide range of insects for nectar purposes, ranging from bees, wasps, and flies, to butterflies, beetles, and plant bugs, this native species is tolerant of most soil conditions. Its seeds benefit certain species of small native mammals.
Phlox paniculata 'Ditomfra'	An attractive nectar source for adult Lepidopterans, this variety of native Phlox has flowers have tall stalks making them unattractive to most other insects. For some moth species, Phlox can also be a larval host plant.
Salvia nemorosa 'Caradonna'	While not an Illinois native, this member of the sage family serves a few garden purposes. Firstly, this plant's pungent leaves act as a repellant to garden pests. Second, the purple flowers serve as another great source of nectar for native pollinators. It is also drought-tolerant and non-invasive.
Oligoneuron rigidum	With its showy yellow flowers, this native, non-aggressive species of goldenrod supports a variety of native pollinators, particularly native bees, including honeybees. It functions as a pollinator plant into the autumn.
Chasmanthium latifolium	Native to the southern half of Illinois, this grass is a wind-pollinated species. Northern Pearl Eye butterfly larvae feed on this species' foliage, as do the caterpillars of various species of native skippers. This plant contributes both environmentally and aesthetically to the plant diversity.
Panicum virgatum 'Apache Rose'	Native to North America, Switch Grass is one of the iconic grasses in tallgrass prairies. It is tolerant of drought and various soil types. An enormous variety of insect species feed on its foliage and the food chains associated with that, and it provides shelter for a variety of small mammals and birds.
Campsis radicans	Native to Illinois, more so in the southern half of the state, this vine provides a significant nectar source for native hummingbirds and orioles, as well as for a variety of sphinx moths, which are long-tongued, and long-tongued bees.
Parthenocissus quinquefolia	The nectar and pollen of this native vine attract a variety of bees, including leaf-cutting bees. Various other insects, such as a variety of boring beetles, aphids, planthoppers, and leafhoppers, feed on this plant's foliage. The larvae of several moths such as sphinx moths also feed on it.
Aronia melanocarpa	This Northeast Illinois native deciduous shrub, tolerant of various moisture levels in soils, has flowers that attract a wide range of insects, which in turn support a large part of the native food web. Its berries are a source of food for some birds, as well as for many mammals, once they fall.
Cornus sericea	Tolerant of a variety of soil conditions, flooding, and dryness. The faunal associations of this shrub are numerous. The nectar and pollen of this shrub's flowers attract and support a very wide variety of insects, and its white drupes are an important food source for many gamebirds and songbirds.
Cercis Canadensis	Easily adaptable to most soil conditions and supports a variety of wildlife, it is pollinated by a wide range of bees, which are attracted to both its pollen and its nectar. This species' leaves, wood, and sap are food sources for various other insects. The seeds are eaten by various species of bird.

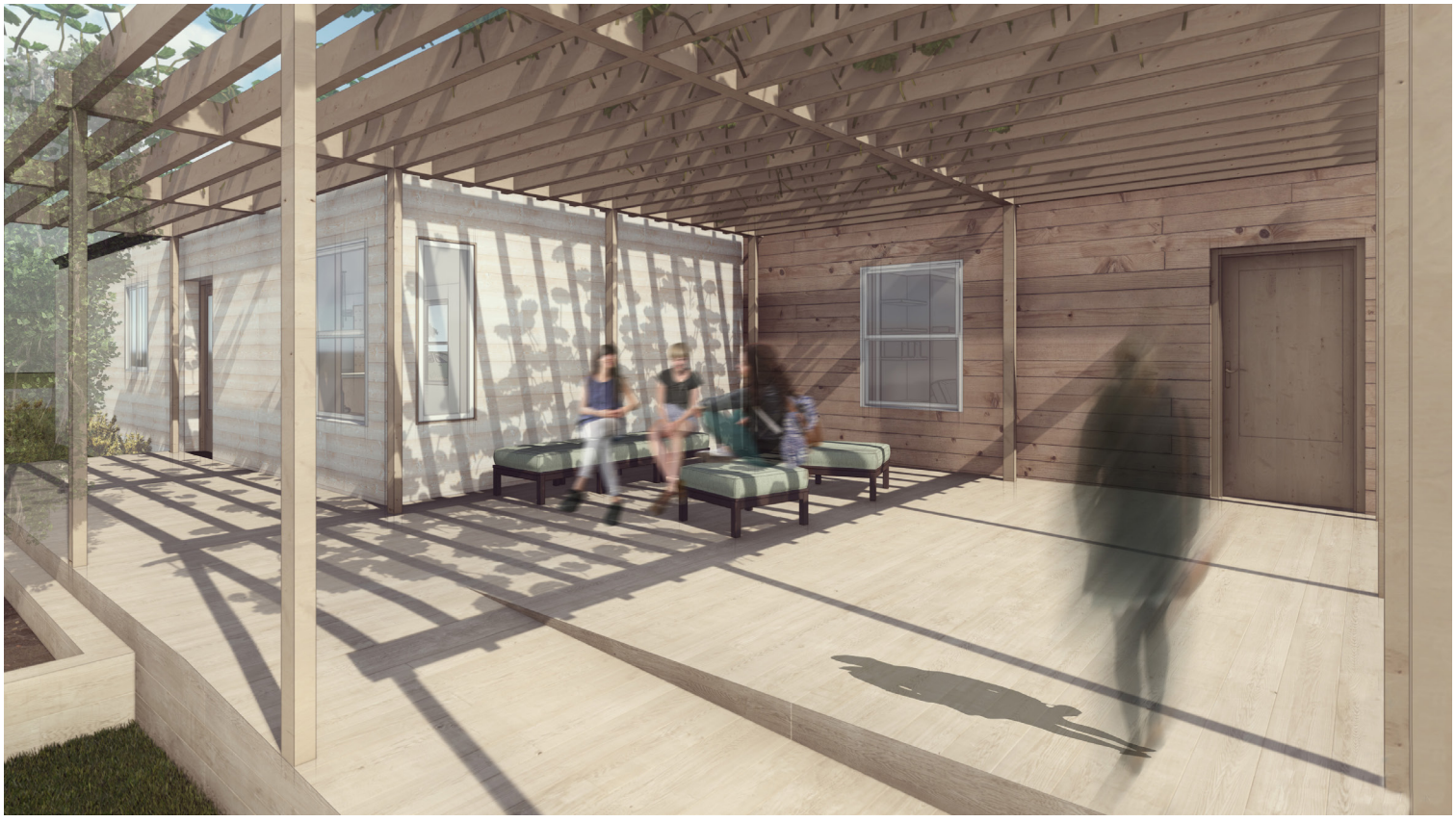
BLOOMING PERIOD



ADAPTHAUS

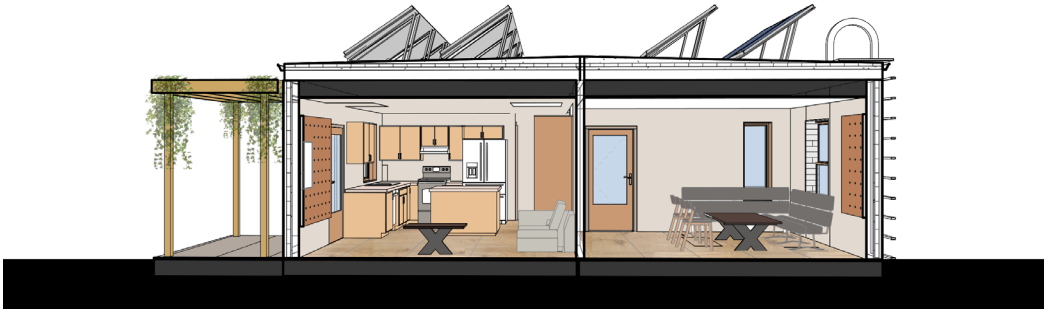
ARCHITECTURE APPENDIX

ARCHITECTURAL RENDERINGS



ARCHITECTURAL RENDERINGS

ARCHITECTURAL SECTIONS
INTERIOR RENDERING



CONSTRUCTION PHOTOGRAPHY

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